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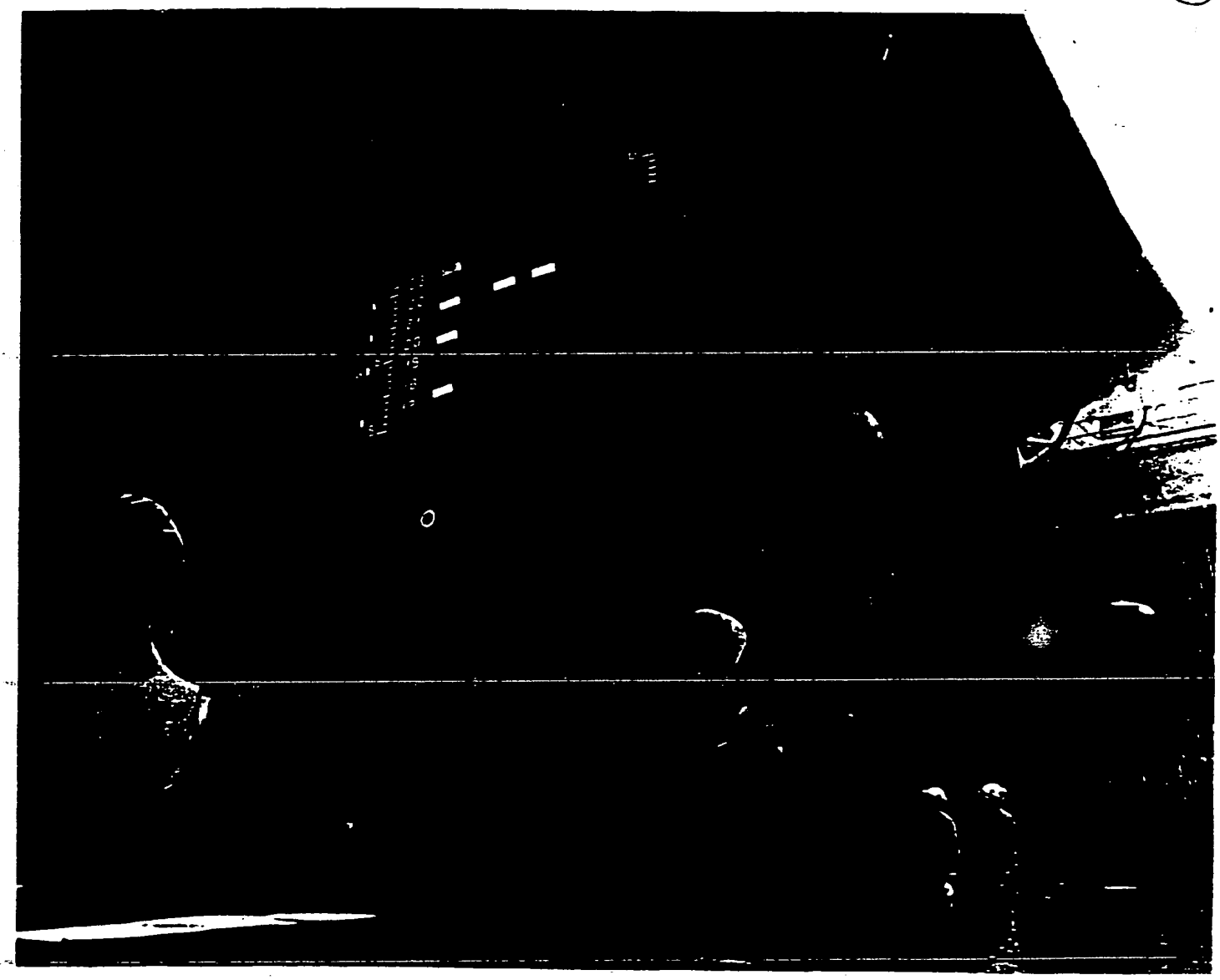
Azipod®

Azimuthing Electric Propulsion Drive



A cruise liner for Carnival Corporation with two 14 MW Azipod units

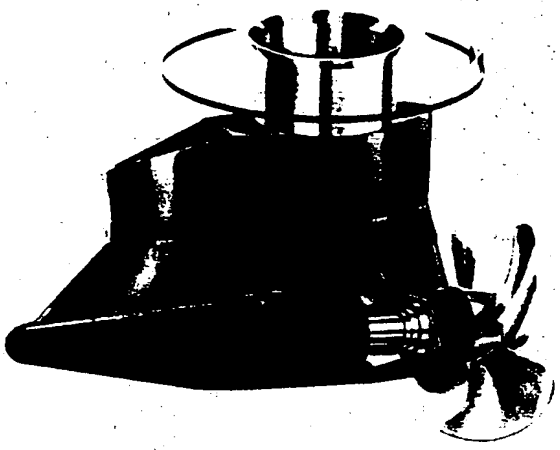
ABB

Azipod® - Azimuthing Electric Propulsion Drive

Azipod is a podded propulsion drive, azimuthing through 360° .

It incorporates an electric single or double winded AC motor, which directly drives a fixed-pitch propeller.

The electric motor, located inside the pod, is controlled by a frequency converter, with full and smooth torque available in either direction - also at low speeds - over a typical speed range of 0 to 300 rpm.



The Azipod unit incorporates an electric AC motor, located inside the pod.

Azipod propulsion for cruise liners

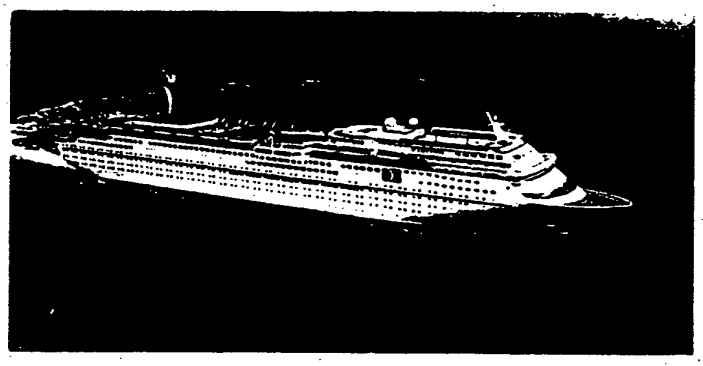
Azipod propulsion has been chosen for two 70,400 GT Fantasy class cruise liners for Carnival Cruise Lines, Inc., USA.
Each ship will receive two 14 MW Azipod units. This allows space and weight savings on board for other advantageous use.
In addition, the Azipod propulsion system improves the ship's fuel efficiency.

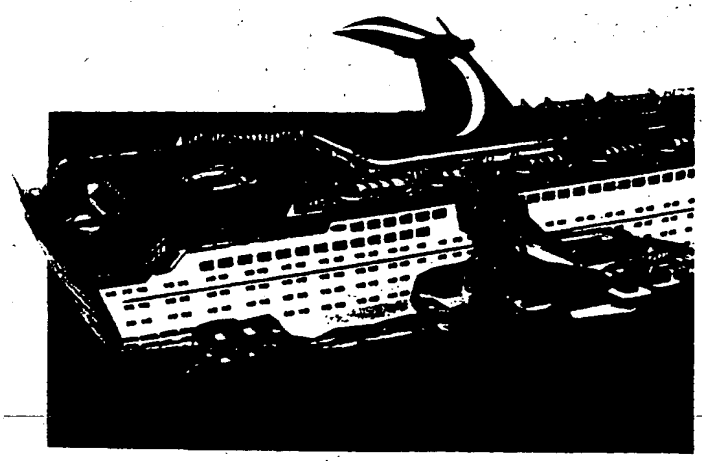
Excellent manoeuvrability and dynamic performance

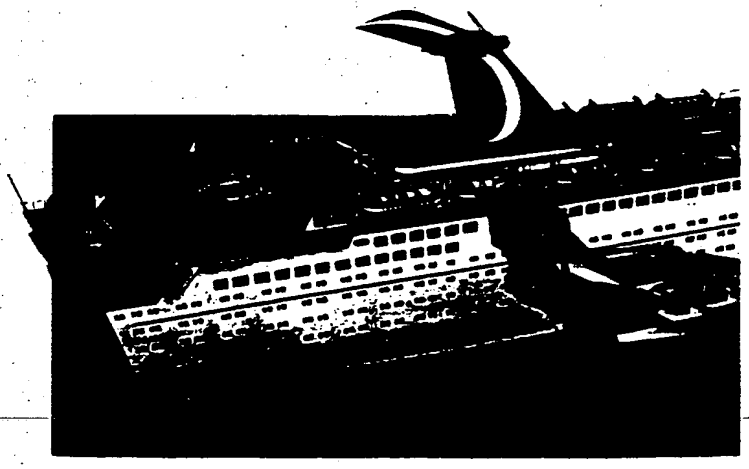
The steering capability is significantly greater than with any conventional rudder system, as the propeller thrust can be directed in any direction. It thus offers excellent manoeuvrability at slow speeds, a feature required in narrow passages and during dynamic positioning in offshore duties, and in heavy weather or arctic conditions. The reversing capability and steering astern are excellent.

Fuel savings through improved hydrodynamic efficiency and the Power Plant Concept

Azipod propulsion makes for additional efficiency gains. The position and angle (both vertical and horizontal) of the propulsion unit under the hull can be selected for an optimum wake field for the propeller. The efficiency losses from reduction gears, long shaft lines, brackets, bossings, rudders and stern thrusters are eliminated.
The Power Plant Concept offers operational and economical benefits for many types of ship. Major power need variations are handled by varying the number of electricity- producing alternators in operation, thus making it possible to run the prime movers near their peak efficiency which means good fuel economy and longer service intervals. Emission levels of nitrogen oxides (NOx) are also considerably lower.

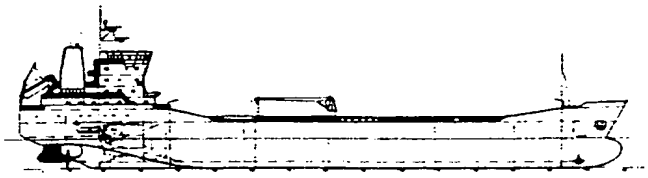




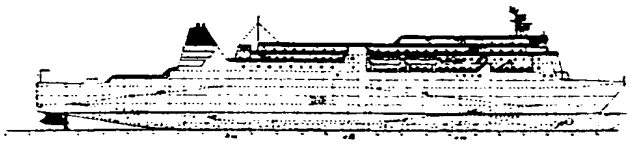


Azipod® Applications

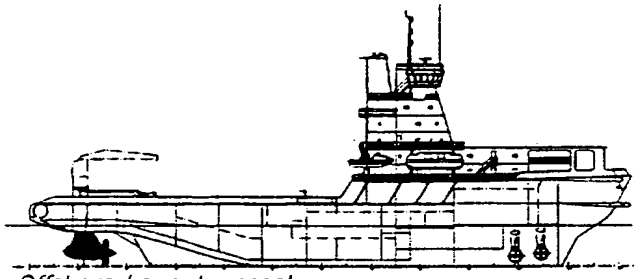
Azipod propulsion is ideal for vessels with varying service profiles needing high manoeuvrability, low noise and vibration, and a flexible machinery arrangement. This includes vessels such as shuttle tankers, cruise liners, ro-ro and passenger/car ferries, icebreakers, research vessels, cable and pipe-laying ships, offshore service vessels, semi-submersible platforms, dredgers, crane ships, naval vessels and vessels for short sea feeder traffic.



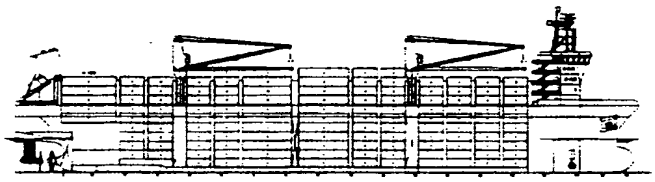
Tanker



Ro- Ro ship



Offshore / supply vessel



Container ship with CRP Azipod

Azipod propulsion eliminates the need for the following separate systems or equipment:

- gearbox and clutch with lube oil system
- thrust bearing
- shaft line
- stern tubes with sealings
- lube oil system for bearings and sealings
- rudders
- steering gear
- stern thrusters
- equipment for CP-propeller

- **The improved propulsion efficiency of Azipod propulsion compensates efficiency losses of electric propulsion compared to those of mechanical drives**
- **With the Power Plant Concept the prime movers can operate close to their peak efficiency resulting in additional fuel savings.**

Double-Acting Azipod Ship (DAS)

A new revolutionary arctic ship concept has been possible to design by using Azipod. The bow of the DAS carrier is optimised for steaming in open water, wheras i hard ice conditions the ship goes with the stern first. Th solution takes advantage of the azimuthing operation of the Azipod propulsion unit.

Azipod® Propulsion Drive

Design

•The design of the Azipod is based on simplicity and reliability.
The short shaft line consists of a propeller,seals,bearings and shaft.

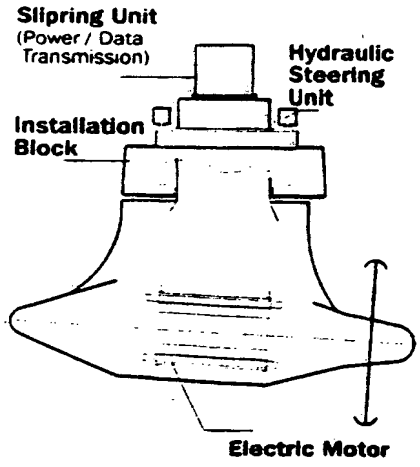
•The single or double winded electric AC motor operates on a voltage of either 9 or 1.5 kV, but lower voltages are possible for smaller units. The power and control data are transferred via sliprings.

•The air cooling system provides cooling air to the motor from the aft compartment.

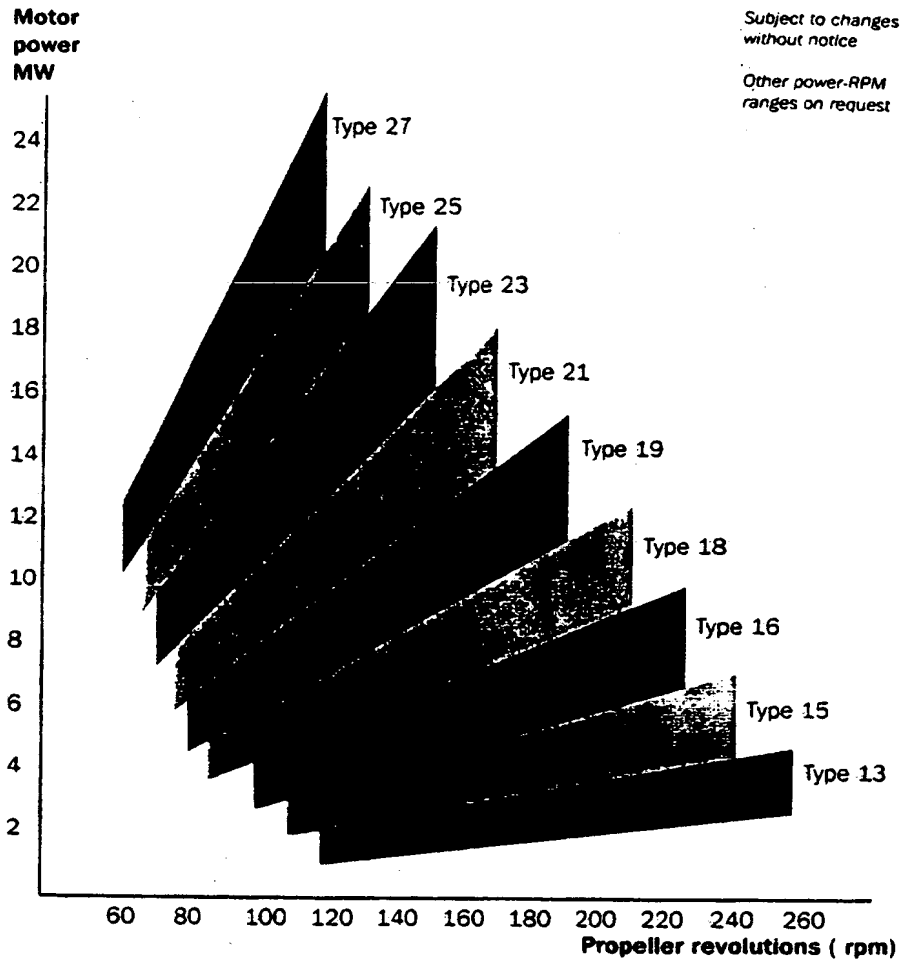
•The steering system consists of two to four hydraulic motors which activate a steel evolvent tiller ring.

•The Azipod control system includes an electric control sub-system on the bridge including all necessary main panels. Besides the Azipod itself, the other components of the electric system are of conventional type: frequency converters, switchboards and generators.

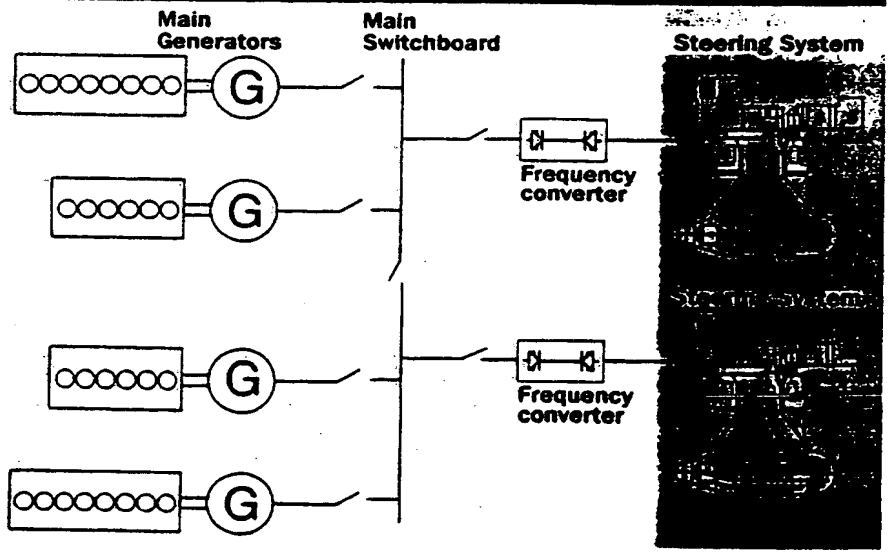
The Azipod unit can be built for pushing or pulling, low or high speeds, open water or icy conditions. The Azipod propellers can be non-skewed or skewed with or without a nozzle.



Power Range



The Power Plant Concept

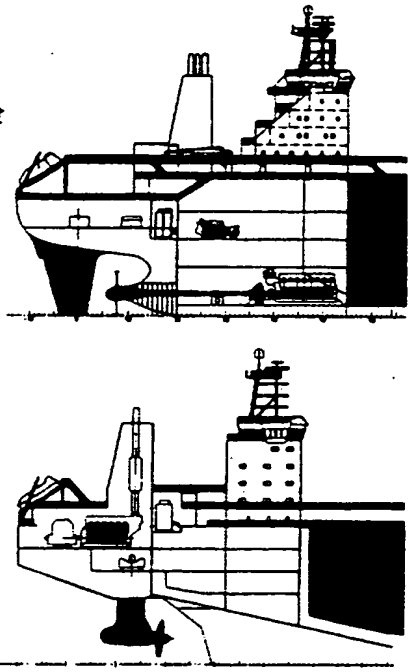


A typical power plant diagram for two Azipod installations.

Space and weight savings

The Azipod eliminates the need for long shaftlines, reduction gears, CP-propellers, rudders, rudder machinery and transversal stern thrusters. The electric propulsion motors are outside the ship's hull.
With the Power Plant Concept, the diesel- or gas turbine-driven alternators can be placed freely on board, to allow for maximum space optimization for other advantageous use.

Diesel-mechanical and Azipod installations on an Arctic 120 000 dwt tanker. (Propulsion power 15 MW)



Low noise and vibrations

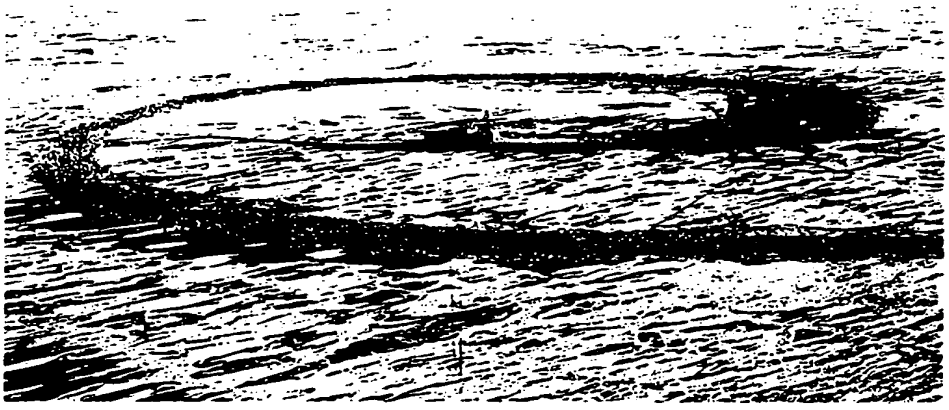
The low noise characteristics of the standard electric drive can be further improved. Hull excitations induced by the propellers are very low due to the optimized propeller wake field, which is further improved by using pulling propellers.

Reduced construction,installation and maintenance costs

Easy installation and freedom in locating the machinery components offer reduced design and construction costs, less capital tied up due to optimized delivery of subcontracted machinery. The reduced number of components means reduced maintenance costs.

Safety and redundancy

The Power Plant Concept provides multiple redundancy in power production. Redundancy and take-me-home capabilities can easily be obtained with twin Azipod drives, with double winded electric motors and two frequency converters. Electric power station machinery can easily be separated into adjacent compartments for redundancy in case of fire or flooding. Excellent manoeuvrability is maintained during crash-stops, and the crash-stop distance is remarkably reduced. A crash reversal can be performed either by reversing the propeller speed from ahead to astern, or by turning the Azipod unit around its vertical axis, maintaining a high propeller speed. This feature improves operational safety.



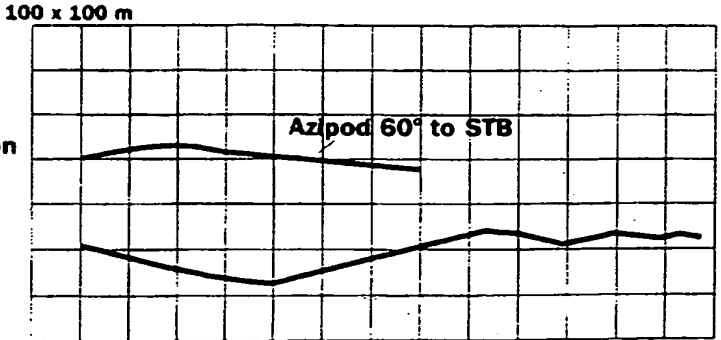
Arctic tanker conversions

The 16,000 dwt Arctic tanker *m/t Uikku* was in 1993 converted with a 11.4 MW Azipod propulsion unit. The sister ship *m/t Lunni* was similarily converted in 1995 based on the excellent performance of *m/t Uikku* in Arctic tansportations on the Northeast Passage.

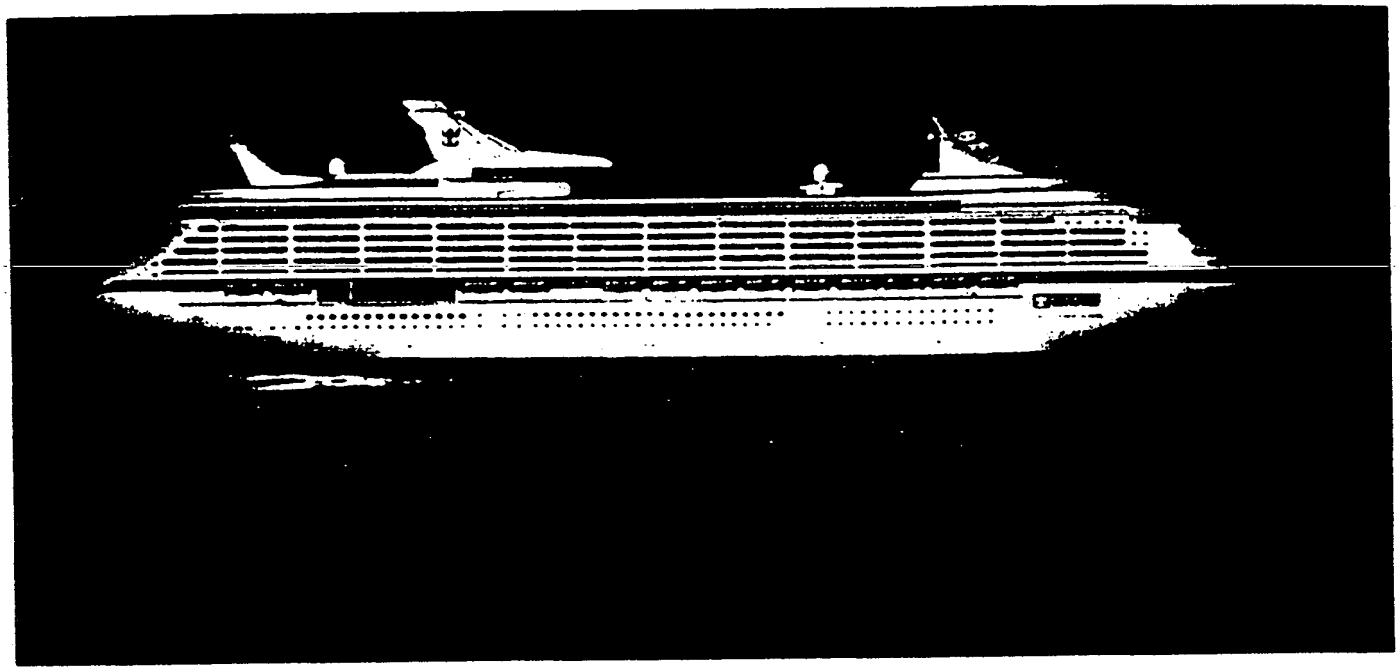
M/T Uikku making turning tests in half meter thick ice

Crash stop

At crash-stops, steering is possible, and the crash-stop distance is remarkably reduced.



The results of m/t Uikku's crash stop test compared to the original performance.



EAGLE-CLASS CRUISE LINERS
Owner: Royal Caribbean International
Gross tonnage: approx. 136 000 GT
Azipod power: 2 x 14 MW (azimuthing),
1 x 14 MW (fixed)
Deliveries: 1999, 2000

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